



## Brief Communication

## Use of sleep medication in children with ADHD

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## SUMMARY

**Objective:** Sleep problems are common in children with attention-deficit/hyperactivity disorder (ADHD), yet little is known about sleep medication use in this population. The aim of this study was to describe sleep medication use, as well as associated child and family characteristics in school-aged children with ADHD.

**Method:** Sleep medication use was ascertained using a prospective parent-completed seven-night sleep and medication log. Exposure variables included socio-demographic characteristics, total sleep problem severity (Children's Sleep Habits Questionnaire), ADHD severity and subtype (ADHD Rating Scale IV), ADHD medication use, internalising and externalising co-morbidities (Anxiety Disorders Interview Schedule for Children/Parent version IV) and parent mental health (Depression Anxiety Stress Scale).

**Results:** Two hundred and fifty-seven children with ADHD participated and of these 57 (22%) were taking sleep medication (melatonin 14% and clonidine 9%). Sleep medication use was associated with combined-type ADHD and ADHD medication use. The presence of co-occurring internalising and externalising co-morbidities was also associated with sleep medication use in *ad hoc* analyses.

**Conclusion:** Sleep medication use is common in children with ADHD and is associated with combined-type ADHD and use of ADHD medication. Further research is needed on the broad functional benefits and long-term safety of sleep medication in this population.

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## 1. Introduction

Sleep problems, including difficulties with sleep onset and maintenance, are common in children with attention-deficit/hyperactivity disorder (ADHD), with parent-reported prevalence estimates ranging from 55% to 74% [1–3]. Sleep problems are commonly behavioural in nature (e.g., sleep-onset association disorder and limit-setting disorder) [2,3]. Possible mechanisms for sleep problems in children with ADHD include hyperactivity and restlessness related to ADHD itself [4], co-morbidities including anxiety [5] and behavioural disorders and side-effects of medications used to treat ADHD, particularly psychostimulants [6].

Sleep problems in children with ADHD are associated with increased ADHD symptom severity [7] and poorer child and family

**Abbreviations:** ADHD, attention-deficit/hyperactivity disorder; CSHQ, Children's Sleep Habits Questionnaire; RCT, Randomised Controlled Trial; SEIFA, Socio-Economic Indexes for Areas; DASS, Depression Anxiety Stress Scale; SD, standard deviation.

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functioning [3]; thus, their identification and management is important. Management includes attention to sleep hygiene, behavioural interventions and medication, although few studies have systematically examined the efficacy of such interventions in children with ADHD [8–10]. Evidence is also emerging to support the use of certain medications to help with sleep in children with ADHD [11]. Some medications are prescribed solely to assist with sleep (e.g., melatonin), whereas others may help with a range of emotional and behavioural symptoms, as well as potentially targeting improved sleep onset and/or quality (e.g., clonidine and tricyclic antidepressants). Furthermore, medications such as dopamine agonists are occasionally used off-label to assist with restless legs syndrome, which has been associated with ADHD symptoms [12]. The medications most commonly prescribed by Australian paediatricians to treat sleep problems are melatonin, clonidine and antihistamines [13]. Sleep medications may cause side effects or have interactions with other medications, and also introduce a risk of overdose [14].

Little is known about sleep medication use in children with ADHD. We need richer information to inform clinical quality improvement in this population. Therefore, in a sample of children

with ADHD, we aimed to examine: (1) the use of sleep medication and (2) child and family characteristic associated with sleep medication use.

## 2. Methods

### 2.1. Study design and sample

Participants (5–13 years) were eligible if they had an ADHD diagnosis from their paediatrician and current ADHD symptoms assessed via the telephone-administered ADHD Rating Scale-IV [15], with parents rating their child's behaviour off medication (this measure defined ADHD subtype). Children also needed to meet symptom duration, onset and impairment criteria for ADHD. Children were participating in one of two studies: (1) a randomised control trial (RCT) examining the efficacy of a behavioural sleep intervention and (2) a cohort study examining sleep problem trajectories. Study allocation was determined by parent report of child sleep problem severity: "Has your child's sleep been a problem for you over the past 4 weeks?" Children with moderate/severe sleep problems were allocated to the RCT, while children with no/mild problems were allocated to the cohort study. Exclusion criteria were dictated by the RCT and included (1) receiving specialised help for their sleep from a psychologist or specialised sleep clinic and (2) suspected obstructive sleep apnoea.

Ethics approval was granted by the Human Research Ethics Committees of The Royal Children's Hospital (30033; 28017) and the Victorian Department of Education and Early Childhood Development (2010\_000573; 2011\_001307).

### 2.2. Procedures

Children were recruited via 50 paediatricians across Victoria, Australia. Paediatricians sent a study invitation to caregivers of children with ADHD. If caregivers did not opt out within 2 weeks, the paediatrician provided the family's contact details to the research team, who assessed eligibility. Eligible families were mailed an information sheet, consent form, survey and seven-night sleep and medication log.

### 2.3. Measures

#### 2.3.1. Outcome measure (dependent variable)

**2.3.1.1. Sleep medication use.** This was assessed using a prospectively completed seven-night sleep and medication log during a typical school week for the child. Parents were asked to record all medications the child took. 'Sleep medication' use was defined as taking melatonin, clonidine, antihistamines or benzodiazepines on any day after 6 pm.

#### 2.3.2. Exposure measures (independent variables)

**2.3.2.1. ADHD medication use.** This was assessed using the medication log, defined as taking methylphenidate, dexamphetamine and/or atomoxetine on any day.

**2.3.2.2. ADHD symptom severity.** This was assessed using the ADHD Rating Scale IV [15], an 18-item, parent-reported validated measure, where parents rate their child's usual behaviour (i.e., off or on medication).

**2.3.2.3. Total sleep problem severity.** This was assessed via the Children's Sleep Habits Questionnaire (CSHQ) [16], a 33-item measure of disorders of initiating and maintaining sleep.

**2.3.2.4. Mental health co-morbidities.** This was assessed by parent report using the telephone-administered Anxiety Disorders Interview Schedule for Children/-IV [17]. Children screening positive for two or more anxiety disorders or one mood disorder were classified as having an internalising problem [18]. Children screening positive for oppositional defiant disorder or conduct disorder were classified as having an externalising problem.

**2.3.2.5. Depression Anxiety Stress Scale.** This is a validated 21-item measure of adult mental health [19].

**2.3.2.6. Socio-demographic characteristics.** These include child age, gender, parent age and high school completion. Family socio-economic status was assigned according to the child's residential postal code using the Socio-Economic Indexes for Areas (SEIFA) (M: 1000; SD: 100) [20].

### 2.4. Statistical analyses

Associations with sleep medication use were examined in unadjusted analyses, using *t*-tests and chi-squared tests. Significant associations at the 5% level were included in an adjusted logistic regression model to determine which variables were associated with sleep medication use in children with ADHD. Analyses were conducted using Stata 12.0 (Stata Corp, College Station, TX, USA).

## 3. Results

### 3.1. Sample characteristics

Sixty-six percent (257/392) of sleep and medication logs were returned. Respondents were more likely to be socially advantaged than non-respondents but otherwise did not differ (see Table 1). Due to the way the samples were recruited, more children (62%) had moderate/severe sleep problems.

Almost one quarter of children (22%) used sleep medication, with 14% and 9% taking clonidine and melatonin, respectively. Most children took ADHD medication (81%), including stimulants (75%) and atomoxetine (14%), and 7% used other medications, including selective serotonin reuptake inhibitors (3%), atypical antipsychotics (4%) and antiepileptic/mood stabiliser (0.4%). No children took antihistamines, benzodiazepines or dopamine agonists.

### 3.2. Associations between sleep medication use and child and family characteristics

In unadjusted analyses, sleep medication use was associated with ADHD medication use ( $p = 0.007$ ), combined-type ADHD ( $p = 0.003$ ), internalising co-morbidities ( $p = 0.02$ ), externalising co-morbidities ( $p = 0.01$ ) and parent mental health ( $p = 0.02$ ) (see Table 1). However, in adjusted analyses (Table 2) only two of these associations held. Children using ADHD medication were three times (95% confidence interval (CI) 1.0–9.0;  $p = 0.05$ ) more likely to use sleep medication than children not taking ADHD medication; while children with combined-type ADHD were 2.5 times (95% CI 1.1–5.9;  $p = 0.04$ ) more likely than children with inattentive-type ADHD to use sleep medication. Our *ad hoc* adjusted analysis also revealed that children with co-occurring internalising and externalising were two times (95% CI 1.0–3.9;  $p = 0.04$ ) more likely to use sleep medication.

**Table 1**  
Child and family characteristics by sleep medication status.

Child and family characteristics	Taking sleep medication <sup>a</sup>		p
	No (n = 200)	Yes (n = 57)	
<i>Child</i>			
Male (n (%))	173 (86.5)	50 (87.7)	0.81
Age in years (mean (SD))	10.1 (1.9)	10.0 (1.8)	0.71
Taking ADHD medication (n (%))	154 (77)	53 (93)	<b>0.007</b>
Total CSHQ problems (mean (SD))	53.6 (9.7)	56.0 (10.0)	0.11
Total ADHD symptoms (mean (SD))	34.6 (9.1)	35.8 (10.7)	0.38
ADHD subtype (n, (%))			<b>0.003</b>
Inattentive	69 (34.5)	9 (15.8)	
Hyperactive/impulsive	14 (7)	1 (2)	
Combined	115 (57.5)	47 (82)	
Internalising comorbidities (n, (%))	100 (51)	38 (69)	<b>0.02</b>
Externalising comorbidities (n, (%))	113 (58)	42 (76)	<b>0.01</b>
<i>Parent</i>			
Completed high school (n (%))	98 (50)	30 (53)	0.70
SEIFA (mean (SD)) <sup>b</sup>	1014.4 (62.1)	1001.8 (67.8)	0.18
Parent total DASS (SD units) mean (SD)	29.7 (22.5)	38.3 (27.4)	<b>0.02</b>

<sup>a</sup> N's range from 247 to 257.

<sup>b</sup> SEIFA, Socio-Economic Indexes for Areas.

**Table 2**  
Adjusted logistic regression models estimating the odds of children<sup>a</sup> taking sleep medication.

Child and family characteristics	Adjusted odds of taking sleep medication (95% CI) <sup>b</sup>	p
Taking ADHD medication	3.0 (1.0; 9.0)	<b>0.05</b>
ADHD subtype		
Inattentive	Ref	
Hyperactive/impulsive	0.5 (0.1; 5.0)	0.59
Combined	2.5 (1.1; 5.9)	<b>0.04</b>
Internalising comorbidities	1.3 (0.7; 2.7)	0.44
Externalising comorbidities	1.8 (0.9; 3.8)	0.10
Parent total DASS score (SD units)	1.2 (0.9; 1.63) <sup>a</sup>	0.25

<sup>a</sup> n = 239 included in adjusted analysis.

<sup>b</sup> Adjusted model includes: ADHD medication use (yes/no), ADHD subtype, internalising comorbidities, externalising comorbidities and parent total DASS scores (SD units).

## 4. Discussion

More than one in five children with ADHD took sleep medications. Sleep medication use was associated with ADHD medication use and combined-type ADHD. The association with ADHD medication may reflect the association between stimulant medication use and delayed sleep onset [4] which in turn may lead to sleep medication use. However, children with ADHD have a high rate of sleep onset disorder irrespective of medication status [2]. Therefore, a more likely explanation is that ADHD medication use is a marker for more severe ADHD, which may be associated with sleep problems [3]. Alternatively, it may reflect parental preference for pharmacological treatments. The association with combined-type ADHD once again may reflect the association between sleep problems and more severe ADHD symptoms [5]. Whilst internalising and externalising co-morbidities were associated with sleep medication use in the unadjusted analyses, these relationships did not hold in adjusted analyses. It is possible our study was underpowered to detect these associations. However, the presence of co-occurring internalising and externalising co-morbidities was associated with sleep medication use. Parents with ADHD commonly report that anxiety symptoms prevent sleep onset, and that defiant behaviour at bedtime causes delays in getting into bed and falling asleep. When these co-morbidities co-occur, they may

produce more severe sleep problems, which may lead to sleep medication use.

Interestingly, there was no association between parent-reported total sleep problem severity and use of sleep medications. This may indicate that factors other than sleep problem severity are operating in decisions to use sleep medications. It is also possible that sleep problem severity improved after commencing sleep medication. Future studies should measure sleep problems prior to sleep medication commencement.

Our study had some limitations. We were unable to ascertain the indication for medication prescription and we did not have a control group. The prevalence of sleep problems, and the associated use of sleep medications, may be higher in our sample compared to children with ADHD generally, as children were recruited for sleep-related studies, with 62% having moderate/severe sleep problems by parent report. Nonetheless, the factors associated with sleep medication use should be similar, so we believe our findings are generalisable to the population of children with ADHD.

Our study also has a number of strengths. To our knowledge, it is the first study to document sleep medication use in a large sample of children with ADHD. Our measure of medication use was drawn from prospectively collected information over a seven-night period. Future research is warranted into sleep medications in children with ADHD, as they appear to be widely used despite limited data on broad functional benefits or risk of long-term side effects.

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## Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <http://dx.doi.org/10.1016/j.sleep.2013.10.018>.

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